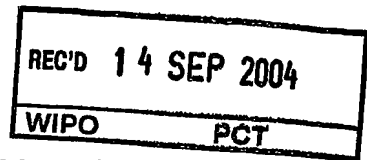


**PATENT COOPERATION TREATY  
PCT**

**INTERNATIONAL PRELIMINARY EXAMINATION REPORT**

(PCT Article 36 and Rule 70)



Applicant's or agent's file reference FP18559:GR	<b>FOR FURTHER ACTION</b> See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416).	
International Application No. <b>PCT/AU2003/001330</b>	International Filing Date (day/month/year) 9 October 2003	Priority Date (day/month/year) 9 October 2002
International Patent Classification (IPC) or national classification and IPC Int. Cl. <sup>7</sup> C25C 5/00, C22B 9/14, 34/12		
Applicant BHP BILLITON INNOVATION PTY LTD et al		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 5 sheets, including this cover sheet.

☐ This report is also accompanied by ANNEXES, i.e., sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of sheet(s).

3. This report contains indications relating to the following items:

- I ☒ Basis of the report
- II ☐ Priority
- III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV ☐ Lack of unity of invention
- V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI ☒ Certain documents cited
- VII ☐ Certain defects in the international application
- VIII ☐ Certain observations on the international application

Date of submission of the demand 22 April 2004	Date of completion of the report 30 August 2004
Name and mailing address of the IPEA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaaustralia.gov.au Facsimile No. (02) 6285 3929	Authorized Officer  <b>DAVID K. BELL</b> Telephone No. (02) 6283 2309

# INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.

PCT/AU2003/001330

## I. Basis of the report

1. With regard to the **elements** of the international application:
  - ☒ the international application as originally filed.
  - ☐ the description, pages , as originally filed,  
pages , filed with the demand,  
pages , received on with the letter of
  - ☐ the claims, pages , as originally filed,  
pages , as amended (together with any statement) under Article 19,  
pages , filed with the demand,  
pages , received on with the letter of
  - ☐ the drawings, pages , as originally filed,  
pages , filed with the demand,  
pages , received on with the letter of
  - ☐ the sequence listing part of the description:  
pages , as originally filed  
pages , filed with the demand  
pages , received on with the letter of
2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item. These elements were available or furnished to this Authority in the following language which is:
  - ☐ the language of a translation furnished for the purposes of international search (under Rule 23.1(b)).
  - ☐ the language of publication of the international application (under Rule 48.3(b)).
  - ☐ the language of the translation furnished for the purposes of international preliminary examination (under Rules 55.2 and/or 55.3).
3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:
  - ☐ contained in the international application in written form.
  - ☐ filed together with the international application in computer readable form.
  - ☐ furnished subsequently to this Authority in written form.
  - ☐ furnished subsequently to this Authority in computer readable form.
  - ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
  - ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished
4. ☐ The amendments have resulted in the cancellation of:
  - ☐ the description, pages
  - ☐ the claims, Nos.
  - ☐ the drawings, sheets/fig.
5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).\*\*

\* Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17).

\*\* Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report

## INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.

PCT/AU2003/001330

**V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement****1. Statement**

Novelty (N)	Claims 1 to 24	YES
	Claims	NO
Inventive step (IS)	Claims 1 to 24	YES
	Claims	NO
Industrial applicability (IA)	Claims 1 to 24	YES
	Claims	NO

**2. Citations and explanations (Rule 70.7)**

D1 = WO 2003076692  
D2 = WO 2003076690  
D3 = WO 2002083993

The invention as defined in the present application is a method of reducing a metal oxide (such as titania) in a solid state using an electrolytic cell that includes a molten electrolyte, a cathode, formed at least in part from the metal oxide, in contact with the electrolyte, a molten (silver or copper) anode and a membrane that is permeable to oxygen and impermeable to dissolved metal in the electrolyte (optionally the membrane is impermeable to any one or more of electrolyte anions other than oxygen, anode metal cations and any other ions and atoms). The problem that the invention attempts to solve is the prevention of back reaction of dissolved metal in the electrolyte and oxygen atoms generated at the anode that can significantly reduce the current efficiency of the cell. The membrane is formed from yttria stabilised zirconia

WO 2002083993 (D3) discloses a method of reducing a metal oxide (such as titania) in a solid state using an electrolytic cell that includes a molten electrolyte, a cathode, formed at least in part from the metal oxide, in contact with the electrolyte, and a molten (silver or copper) metal anode in contact with the electrolyte. D3 therefore discloses all the features of the present invention except for the use of the membrane, for the prevention of ions or atoms except oxygen, migrating between the anode and the cathode.

The document D1 (WO 2003076692) discloses a method of reducing a metal oxide (such as titania) in a solid state in which the electrolytic cell includes a molten electrolyte, a carbon anode and a cathode, formed at least in part from the metal oxide. D1 also discloses the use of a membrane that is permeable to oxygen and impermeable to carbon in ionic and non-ionic forms positioned between the cathode and the anode to prevent migration of carbon to the cathode. D1 specifies that the membrane may be formed of any suitable material and that one suitable material tested was yttria stabilised zirconia. D2 (WO 2003076690) discloses a method of reducing a metal oxide (such as titania) in a solid state having the same features as disclosed in D1.

Continued in Supplemental Box

# INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.  
**PCT/AU2003/001330**

## VI. Certain documents cited

### 1. Certain published documents (Rule 70.10)

Application No. Patent No.	Publication date (day/month/year)	Filing date (day/month/year)	Priority date ( valid claim) (day/month/year)
WO 2003076692	18 September 2003	13 March 2003	13 March 2002
WO 2003076690	18 September 2003	13 March 2003	13 March 2002
WO 2002083993	24 October 2002	10 April 2002	10 April 2001

### 2. Non-written disclosures (Rule 70.9)

Kind of non-written disclosure	Date of non-written disclosure (day/month/year)	Date of written disclosure referring to non-written disclosure (day/month/year)
--------------------------------	--	---

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.

PCT/AU2003/001330

**Supplemental Box**

(To be used when the space in any of the preceding boxes is not sufficient)

**Continuation of**

D1 and D2 clearly state that the problem to be solved in each case is preventing ion or non-ionic carbon from migrating between the anode and the cathode (D2 page 6 line 35 to page 7 line 18, D1 page 3 lines 13 to 32). The prevention of carbon contamination is not the same problem to be solved as the prevention of back (oxygen) reactions in the present invention. None of the cited documents disclose or fairly suggested, either singly nor in obvious combination, the invention as defined in the present claims. The claimed invention is therefore novel, involves an inventive step and is industrially applicable. .